

Software Systems Verification and Validation

Assoc. Prof. Andreea Vescan Lecture 4: Levels of testing

Babeş-Bolyai University

Cluj-Napoca

2019-2020

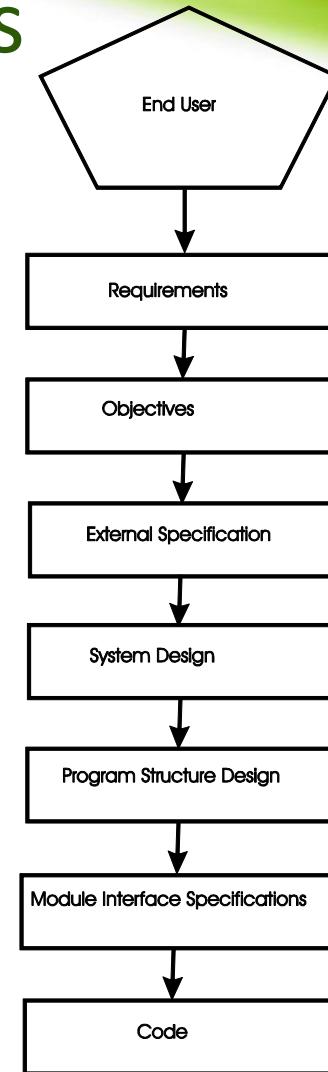


Outline

- Software development process
 - Software development process
 - Development and testing processes
- Levels of testing
 - Unit testing
 - Integration testing
 - Function testing
 - System testing
 - Acceptance testing
- Retesting vs regression testing
- Next lecture:
 - Agile testing
- Questions

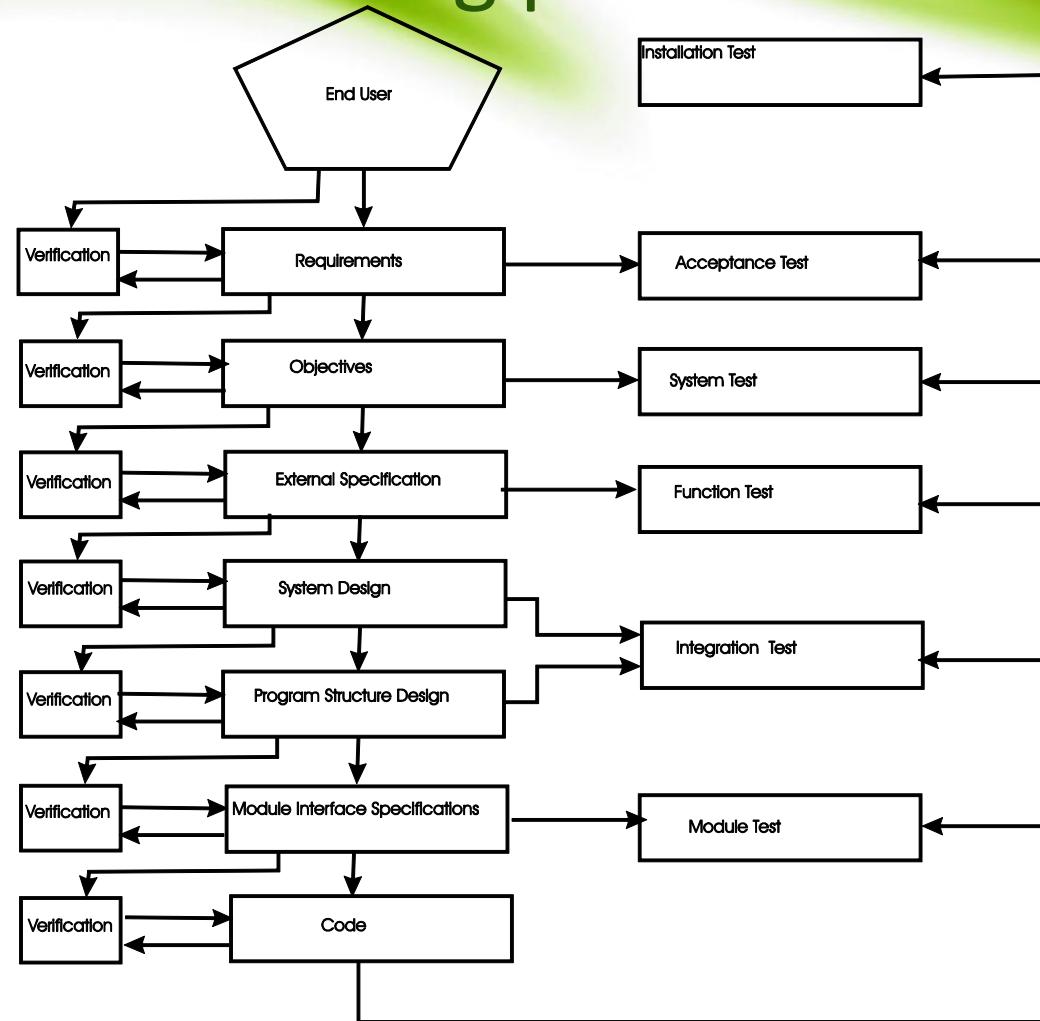
Software development process

- user's needs are translated into requirements
- requirements are translated into objectives
- objectives are translated into external specification
- system design
- program structure design
- module interface specification
- code



Development and testing processes

- Approaches to prevent errors:
 - More precision into the development process.
 - Introduction of a verification step at the end of each process.
 - Orient distinct testing processes toward distinct development processes.



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Levels of testing

1. Unit testing

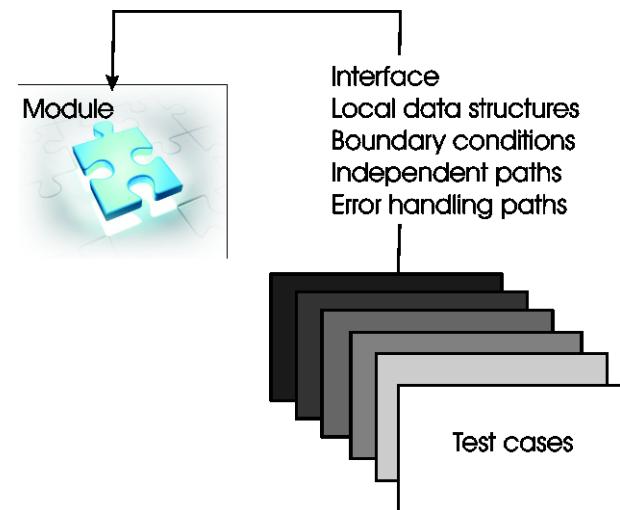
- Testing individual subprograms, subroutines, procedures, the smaller building blocks of the program.
- **Motivations:**
 - Managing the combined elements of testing.
 - Module testing eases the task of debugging.
 - Module testing introduces parallelism into the program testing process.
- **Points of view**
 - The manner in which test cases are designed.
 - The order in which modules should be tested and integrated.
- Advice about performing the test.
- References: [Mye04] (chapter 5),[NT05] (chapter 3).

Levels of testing

1. Unit testing (cont)

Test case design

- Information needed when designing test cases for a module:
 - specification of the module
 - the module's source code
- Test case design procedure for a module test is:
 - Analyze the logic of the module using white-box methods.
 - Applying black-box methods to the module's specification.

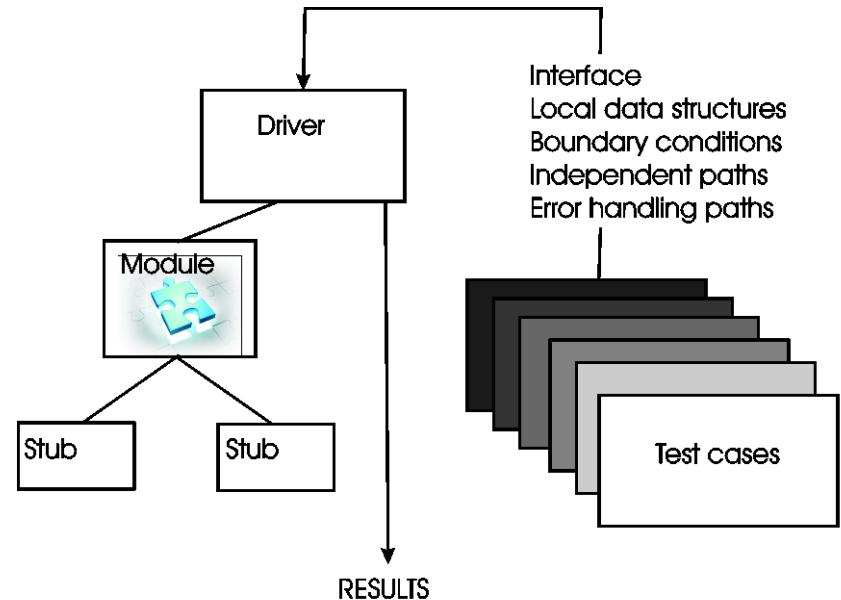


Levels of testing

1. Unit testing (cont)

Unit test procedures

- Unit test environment
 - **driver** - a “main program” that accepts test case data, passes such data to the component to be tested and prints relevant results;
 - **stub** - serve to replace modules that are subordinate the component to be tested.
 - uses the subordinate module’s interface
 - may do minimal data manipulation
 - prints verification of entry
 - returns control to the module undergoing testing.



Levels of testing

2. Integration testing

- Constructing the program structure while at the same time conducting tests to uncover errors associated with interfacing.
- **Importance of integration testing:**
 - Different modules are generally created by groups of different developers.
 - Unit testing of individual modules is carried out in a controlled environment by using test drivers and stubs.
 - Some modules are more error prone than other modules.
- Objectives:
 - putting the modules together in an incremental manner
 - ensuring that the additional modules work as expected without disturbing the functionalities of the modules already put together.
- Reference: [NT05] (chapter 7).

Levels of testing

2. Integration testing (cont)

Techniques [Fre10]

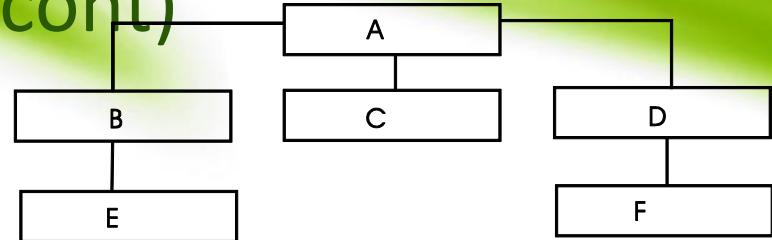
- Big-bang
- Incremental
 - Top-down.
 - Bottom-up.
- Sandwich.

Levels of testing

2. Integration testing (cont)

Big-bang testing

- Big-bang procedures:
 - Module test for each individual unit;
 - A driver module;
 - Several stub modules.
 - The modules are combined to form the program.
- **Observations**
 - more work for big-bang
 - mismatching interfaces/incorrect assumptions among modules - detected earlier with incremental
 - Debugging easier - incremental
 - Big-bang - appears to use less machine time
 - parallel activities – opportunity for big-bang

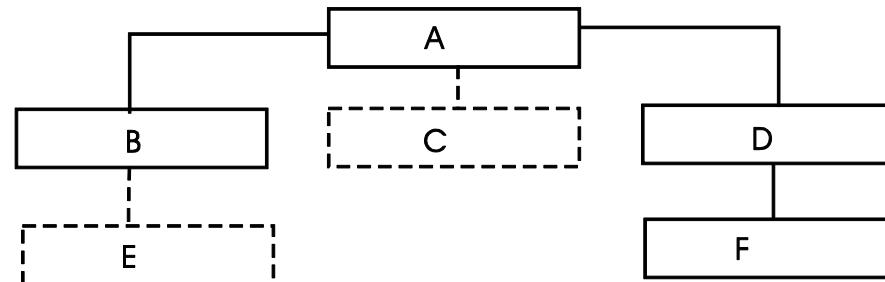


Levels of testing

2. Integration testing (cont)

Top-down incremental testing

- Top-down integration manner:
 - Depth-first integration;
 - Breadth-first integration.
- Top-down integration process:
 - main control module = driver;
 - stubs=substituted for all components directly subordinate;
 - subordinates stub ← actual components;
 - tests are conducted as each component is integrated;
 - on completion of each set of tests, another stub ← real component;
 - regression testing may be conducted.

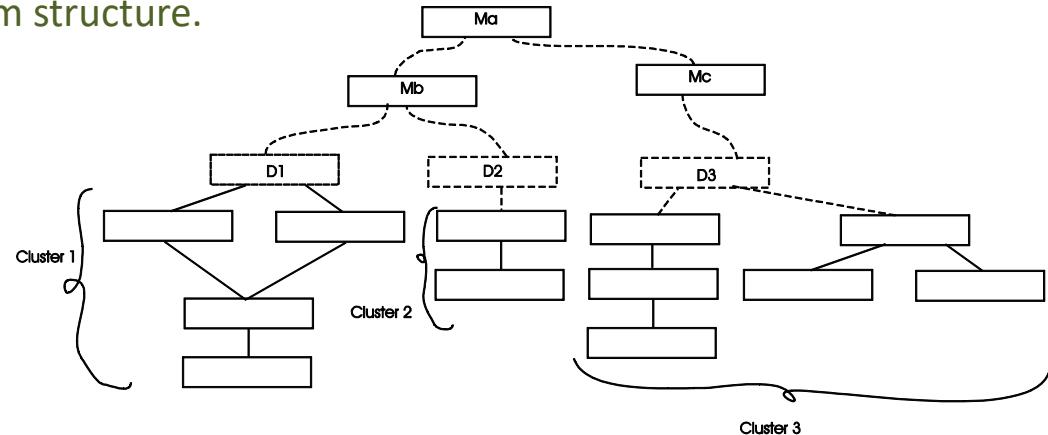


Levels of testing

2. Integration testing

Bottom-up incremental testing

- Bottom-up integration process:
 - low-levels components are combined into clusters;
 - a driver is written to coordinate test case input and output;
 - the cluster is tested;
 - drivers are removed and clusters are combined moving upward in the program structure.

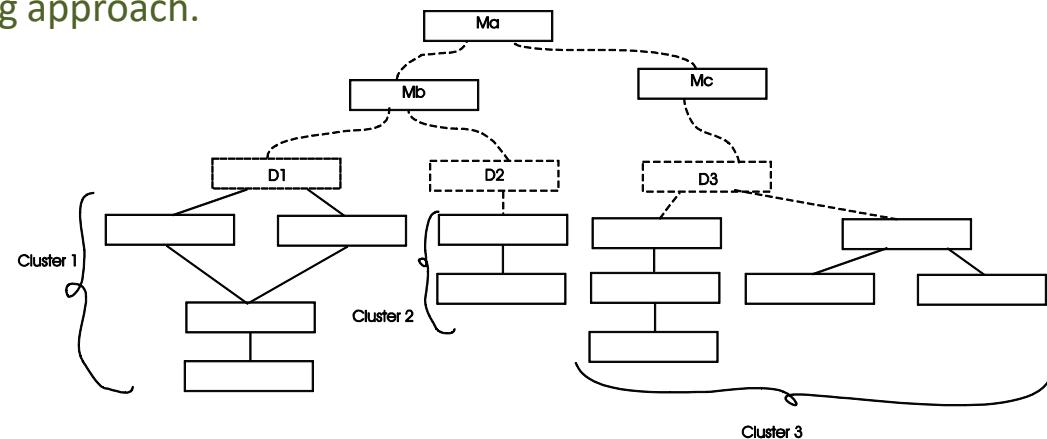


Levels of testing

2. Integration testing

Sandwich testing

- Sandwich procedures:
 - mix of the top-down and bottom-up approaches;
 - layers of a hierarchical system:
 - bottom-layer – using bottom-up module integration;
 - top-layer - using top-down approach integration;
 - middle-layer - big-bang approach.



Levels of testing

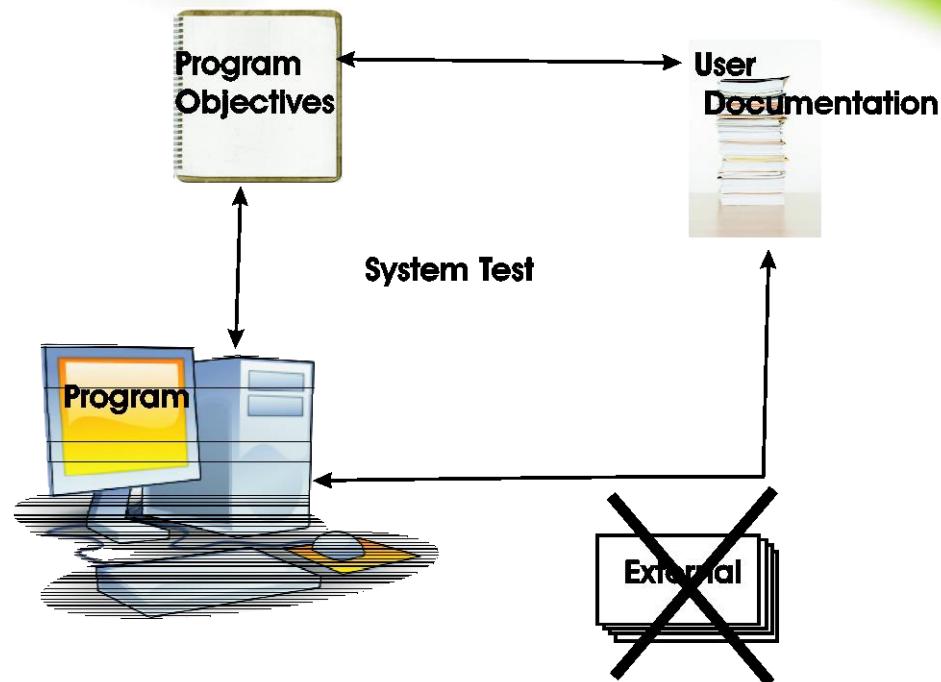
3. Function testing

- testing requirements described in the external specification of the system;
 - a process of attempting to find discrepancies between the program and the external specification.
 - a black-box activity
 - uses system specification
-
- References: [Mye04] (chapter 6), [NT05] (chapter 9), [PY08] (chapter 10).

Levels of testing

4. System testing

- compare the program - original objectives.
- Use external specification? no, may appear defects during the process of translating the objectives in external specifications;
- Use objectives documents? no, do not contain exact description of the external interfaces of the program;
- Use program's user documentation
- References:[Mye04] (Chapter 6), [NT05] (chapter 8), [PY08] (chapter 22).



Levels of testing

4. System testing (cont)

- the objectives does not offer information about the functionality of the system (interfaces of the modules being tested)
- there is no methodology for created test cases in system testing???
- the process of creating test cases: use imagination, creativity and experience

Levels of testing

4. System testing (cont)

System testing types

- In [Mye04] (Chapter. 6) there are 15 types of system testing:
 - Facility testing
 - Volume testing
 - Usability testing
 - Recovery testing
 - **Security testing – Details in next lectures**
 - **Stress testing**
 - **Performance testing – Details – IT firm EVOZONE – Lecture invitation (Tentative)**
 - Storage testing
 - Configuration testing
 - Compatibility testing
 - Instability testing
 - Reliability testing
 - Serviceability testing
 - Documentation testing
 - Procedure testing

Levels of testing

5. Acceptance testing

- a process of comparing the program to its initial requirements and the current needs of its end user;
 - not the responsibility of the development organization;
 - the customer first performs an acceptance test to determine whether the product satisfies its needs.
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- References: [NT05] (chapter 14), [PY08] (chapter 22).

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Testing level vs. Testing type

Testing level

- set of activities that are associated to a phase of the software development product

Testing type

- the mean by which an objective of a testing level is achieved

Examples

- Testing a function – unit level or integration level by bbt(domain)/wbt
- Testing of a non-functional characteristic – at system level by performance testing or usability testing
- Testing after eliminating a bug – at any level after debugging/correcting the bug by applying retesting, confirmation testing
- Testing relating to eliminating a bug – at any level by regression testing to verify if the elimination of the bug doesn't have side-effects

Retesting (confirmation testing)

- Retesting
 - Execution of the test cases that revealed a bug that was reported
 - Goal – confirmation that the bug was eliminated
- Test cases – are the same with those already executed

Regression testing

- Regression testing - **the re-execution of some subsets of tests that have already been conducted** to ensure that changes have not propagated unintended side effects.
- Regression test suits - classes of test cases:
 - Tests to exercise all software functions.
 - Tests that focus on software functions that are likely to be affected by the change.
 - Tests that focus on the software components that have been changed.
- Reference: [PY08] (chapter 22).
- Regression testing – **new test cases** (Cem Kaner) [BBST]

Surprise!





Having fun learning about testing

Easter eggs – in testing

- For students that participated in Lecture 04
 - If you plan to do this Bonus, please indicate NOW (during the lecture hours) in the chat channel live as a comment.
- 25 XP for each student
- The task must be done **individually**.

- Each student presents 1 real example of Easter egg in testing.
- Present 1 A4 page information in Lecture 5 in electronic format, submitted in Canvas (BonusLecture5).
 - Definition/description
 - Example
 - Interesting fact(s)

Surprise!





Having fun learning about testing During Lecture 5 (second hour)

- Big Bang Integration
- Top Down Integration
- Bottom Up Integration
- Sandwich Integration

1 A4 page information (30 minutes)

Work in teams of 2 students

- What it is? Description/Definition,
- Why it's useful,
- Type of projects,
- Testing techniques used
- pro&cons.

- Poster - creating 25 XP
 - Submitted in Canvas in BonusLecture4 by
 - 9:30 on 20March2020
- Poster – discussion Debriefing
 - Learning
 - Individual/Team

Surprise!



Having fun learning about testing During Lecture 4 (take home)

- For students that participated in Lecture 04
 - If you plan to do this Bonus, please indicate NOW (during the lecture hours) in the chat channel live as a comment.

1 A4 page information

Work in teams of 2 students

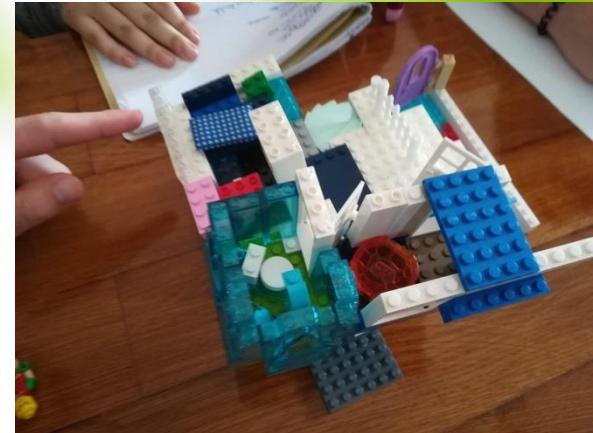
- Definition/description
- Characteristics (5 to 10 points)
- Levels of testing
- Example = simple + real world application
- Interesting fact(s)

1. Guerilla testing
2. Dumb monkey testing
3. Smoke testing
4. Bug bashes (in testing)

- Poster - creating 25 XP
 - Submitted in Canvas in BonusLecture4 by
 - Lecture 5 (27March2020)

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Questions

- Thank You For Your Attention!

References

- [Pat05] R. Patton. Software Testing. Sams Publishing, 2005.
- [PY08] M. Pezzand and M. Young. *Software Testing and Analysis: Process, Principles and Techniques*. John Wiley and Sons, 2008.
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- [You79] E. Yourdon, Structured Walkthroughs, Prentice-Hall, Englewood Cliffs, NJ, 1979
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- [Fre10] M. Frentiu, Verificarea si validarea sistemelor soft, Presa Universitara Clujeana, 2010
- [BBST] BBST Testing course, <http://testingeducation.org/BBST/>